steadily in the same direction—that of improvement. But the great submergence, and severe period which followed it, would exactly bring about the required result, if it can be only shown that the age of Palæolithic man preceded these occurrences.

There is no antecedent improbability in such a supposition; the mild periods that recurred during the formation of the Till may well have been warm enough to allow of northern mammals, and subsequently, as the climate improved, of Palæolithic man and southern forms migrating into our area, to be again driven out each time a return of cold brought the ice-sheet down over the lowlands, and finally expelled, never again to return, by the great submergence. But more than this, our author has shown how anomalies, hitherto inexplicable, receive an easy solution on this hypothesis; how, for instance, it accounts for the mingling of northern and southern forms of mammals in the palæolithic beds; and how it gives a reason for the fact that palæolithic river-gravels are confined to those parts of Britain which were not covered by the ice-sheet, while the palæolithic deposits found in caves are not so restricted.

The hypothesis therefore stands on a firm basis, and the conclusion is irresistible that Palæolithic man was of interglacial—may be of preglacial—date. Thus much had been dimly felt rather than demonstrated by previous thinkers; but Mr. J. Geikie has shed a flood of light on the subject by pointing out that man was driven out of our country by the great submergence; that Britain was not again peopled till the elevation that followed connected it with the continent; and that the colonists belonged to the Neolithic race. In this way he has satisfactorily accounted for the great gap that exists between the two divisions of the Stone-folk.

The reasonable limits of an article are well-nigh reached, but we have by no means exhausted the contents of this comprehensive volume. The chapter on lakes must not be passed by altogether, for besides being a lucid exposition of Prof. Ramsay's theory of the formation of rock-basins, it is illustrated by an admirable map and section of Loch Lomond, and by a beautiful chart of part of the western coast of Scotland, which shows that these hollows are not confined to the land, but are also dotted over the shallow bed of the adjoining sea in exactly the places where a glacialist would expect to find them. The chapter on the English Drift would itself furnish materials for a review, as would also the note distinguishing the formations which are considered to have yielded traces of ice action. On the latter head we may point out that the presence of glaciers or icebergs is not in itself proof of a glacial epoch. Where we find, as in the Permian beds, evidence of the presence of ice at localities so far apart as Ireland, the west of England, and the centre of Germany, it looks like an indication of wide-spread severity of climate; but such a case as the Brecciated Beds of the Ord is better explained by a local development of glaciers, specially as the fauna of the associated strata forbids the existence of a general low temperature. It is worthy of note that these periods, which give the most satisfactory indications of glacial conditions, come close upon others, when a genial climate prevailed far up into northern latitudes; the Permian, for instance, followed hard upon the Carboniferous, and the Miocene epoch, if the glacial character of portions of it be fairly established, would yield a still more striking instance. But these juxtapositions of strongly-contrasted phases of climate, so far from being matter for surprise, are a necessary result of Mr. Croll's theory, according to which each hemisphere would, during a period of high eccentricity, experience alternately the severity of a glacial epoch and eras of almost perpetual spring.

Space will allow us to point out one only of the numerous results which will probably follow from the conclusions of this work. They must lead to a revision of our nomenclature of the Tertiary strata. The conditions of the Pliocene epoch were merely the commencement of a series of changes which received their full development during the Glacial era; and the latter is linked on by an equally unbroken succession of events with modern days. If therefore we are to have a Post-tertiary, Quaternary, or Recent Period, it should on physical grounds include Pliocene times; while the continental character of the Miocene epoch in Europe, and the important events that brought it to an end, mark it out as the natural termination of the Tertiary era.

In conclusion we have only to express a hope that the imperfect sketch we have given of the Great Ice Age may lead many readers to arrive at a fuller appreciation of its merits by turning to the work itself.

A. H. GREEN

SCHWEINFURTH'S "HEART OF AFRICA"

The Heart of Africa; or, Three Years' Travels and Adventures in the Unexplored Regions of the Centre of Africa. By Dr. Georg Schweinfurth. Translated by Ellen E. Frewer. 2 vols. (London: Sampson Low and Co., 1874.)

THE "Heart of Africa" is a valuable contribution to African literature, and we lay down the last volume with regret. This regret is enhanced by the grievous disappointment all geographers must feel that a man so capable and so reliable as Dr. Schweinfurth should have limited his scientific acquirements to botany and natural history without having qualified himself as a traveller by the use of astronomical instruments.

When we first glance at the elaborate map of the author's travels, embracing an extraordinary series of curves, zigzags, and the like, until we reach his most southern limit, we are delighted with this apparently valuable addition to geography, and we feel a first impulse to congratulate Germany as an ally in Central African Exploration, but to our complete dismay after these ardent expectations we find ourselves actually without one astronomical observation.

As geographers, we really have a right to complain. If Dr. Schweinfurth had been an uneducated adventurer, or even a mere sportsman attracted to wild countries by a love of wandering, we should have regretted a barren geographical result after an arduous journey of three years. Dr. Schweinfurth is, on the contrary, a man of scientific education and a botanist—in addition to being an accomplished draughtsman. He is a man of cultivated tastes, and he evidently combines the qualities requisite for a traveller in wild countries. Why should he not have fitted himself prior to his voyage by a few months' study for the only practical and reliable work of a geographer or scientific traveller? In the absence of astronomical observations we can only regard his map as the author's *idea* of his journey. We have no compass bearings or any reference to such observations having been taken. We must therefore accept his map as simply a conscientious endeavour to introduce us to his wanderings; at the same time, geographically speaking, we can only allow that he has been wandering about in the "Heart of Africa." It is with regret, therefore, that we cannot accept him in the first rank of geographers. A future traveller over the same ground may contest every position; thus, instead of our author's journey having added to our geographical knowledge, it may simply add to those geographical strifes which are the inevitable results of un-scientific journeys.

Having, as a matter of duty, expressed this opinion upon a work otherwise most valuable, it is a pleasure to be able to grasp one geographical fact that is well established, and is independent of astronomical observations. This is the watershed towards the West which forms the boundary of the Nile Basin. The large flow of water discovered by Dr. Schweinfurth is passing towards the Atlantic. This at once disproves the theories laid down by Livingstone, but never accepted by geographers, that he rivers to the west of the Tanganika Lake flowed northward to the Nile. As Schweinfurth passed out of the Nile Basin in about 28° E. long., so also Livingstone arrived in a western watershed south of the equator in about the same meridian.

The botanical information collected by Dr. Schweinfurth is invaluable, and can only be estimated by a professional botanist. We envy the traveller in many of his floral rambles, which are described with the energy and vividness of an enthusiast. Nothing new has been added to the known list of African fauna. We conclude, from the description of the habits of the so-called "rock rabbit," that our author means the "hyrax," which, although resembling a rabbit in appearance, is not a rodent.

Dr. Schweinfurth having been properly supported by an introduction from the Berlin Academy was saved many difficulties to which other travellers have been subjected; he was well received by Djiaffer Pacha, the Governor-General of Soudan, at Khartoum, who handed him over to the care of one Ghattas, a Coptic slave trader and ivory merchant. Ghattas entrusted him to the guidance of his own people, who appear to have behaved extremely well. Dr. Schweinfurth had every opportunity of examining the mysteries of the slave trade, and he is perfectly right in his description of the immense importance of the Darfur and Kordofan route, by which vast multitudes are conveyed who can thus elude the cruisers on the White Nile. At the same time the author is in error and has been purposely deceived by his informants (themselves slave traders) when (p. 429, vol. ii.), speaking of the upper district of the White Nile, inclusive of the Albert and Victoria Lakes, as one of the territories that form the sources of the slave trade in north-eastern Africa, he says, "The expedition of Sir Samuel Baker has stopped this source. The annual produce in the most favourable years did not exceed 1,000." There were no less than ten slave stations situated in the territory under Sir Samuel Baker's command. In each of these stations were at least 1,000 slaves.

The last act of Sir Samuel Baker, on his homeward route, was to overtake three vessels from the Bohr, lat. 5°·20 N., with 700 slaves on board, which were openly on their route to pass the Government station of Fashoda! thus proving what Dr. Schweinfurth himself states respecting the connivance of the Egyptian officials, p. 442, vol. ii.—"In Kordofan, where there is a resident Egyptian Governor, the trade is truly enormous, and there is now as well the slave-trade from Darfur." In a cursory review of the slave-trade Dr. Schweinfurth makes a remark that few Englishmen would sanction, p. 433, vol. ii.—"Two great nations have speeded on the work, England in theory, North America in practice." If the payment of twenty millions sterling for emancipation was not the most practical, and not only theoretical, work, we really do not understand what practice means.

It would have been interesting had Dr. Schweinfurth given us more details of the ivory trade carried on by the people who acted as his chaperons in Africa. These were avowedly slave traders, and we should be gratified to learn that they formed some exception to the rule, and actually traded with merchandise instead of bartering slaves and stolen cattle for ivory.

The reward of ignorant ages to the returned traveller was general incredulity. Even in the present day there are ignorant persons who question the existence of cannibalism. Dr. Schweinfurth has arrived fresh from the cannibals of Monbuttoo with human skulls and bones almost warm from the saucepans of the savages. He can even describe the sauces which these gourmands use in their dainty dishes. Mushrooms and capsicums for a "sauce piquante aux champignons" are the literal civilised adjuncts for a dish off a stewed baby, only two days old, whose mother had deserted it! The baby was dying while the preparations for cooking it were already commenced. This is the real truth and no traveller's joke, as the babies and fond mothers would quickly discover should they visit the tribe of Monbuttoo. It may be asked, "How did Dr. Schweinfurth escape?" but it must be remembered that the Monbuttoo do not eat men of science, who are generally very lean. A fat missionary, with a family fresh from Exeter Hall, may meet with immediate attention, with the warm but brief Monbuttoo invitation, "walk in."

It would be useless for us to closely criticise this book. Few books are perfect. There may be a little excess of detail of the dull routine of African daily life that if omitted would have reduced two bulky volumes to a more convenient size. But on the other hand, some people like bulky volumes and enjoy as many pounds avoirdupois as they can obtain for their money; just as some people, especially the rural population, enjoy long sermons.

We cordially recommend all interested in exploration to read the book, at the same time reminding them that they may safely rely upon the high character and status of the author; for although Dr. Schweinfurth fails as a scientific geographer, he in no way fails as a scientific explorer devoted to the particular object of his studies—botany. In this branch of science he is better qualified than any former African traveller.

Such men as Dr. Schweinfurth will always have the regard and esteem of all true friends of Science; he belongs to the same metal that has already formed a wedge which will force open the secrets of inner Africa.

OUR BOOK SHELF

Adulterations of Food, with short Processes for their Detection. By Rowland J. Atcherly, Ph.D., F.C.S. (London: W. Isbister & Co., 56, Ludgate Hill, 1874.)

THE attempt to notice the adulterations of food in 100 pages of large type is a somewhat rash one, and it is not therefore surprising that the author of the treatise is frequently compelled to dismiss his subject in a very cursory manner.

For two of the classes of readers whom he addresses, the dealer and consumer, the work will no doubt be of use, and it is also likely to be useful to the chemist, as affording him a brief conspectus of the most likely adulterants in any particular article. Of what use, however, the last 12 pages of letterpress describing the making and use of volumetric solution are to the "trained chemist," to whom the author addresses them, we are at a loss to conceive.

The information given in the part upon adulterations is generally sound, though the statement on p. 34 that prussic acid is found when nitro-benzol has been used as a flavouring is absurd; so far is this from being the case, that it would be an indication of the use of a genuine but insufficiently purified oil of bitter almonds. The process for detecting alum in bread on p. 15 is also very unsatisfactory, and certainly not adapted for the use of either dealer or consumer. The book concludes with 21 neatly executed cuts of various starches, chicory, cocoa, tea-leaves and adulterating leaves found in tea, &c., as seen under the microscope. In conclusion, we would advise the author in a future edition to considerably expand the part on adulteration and to entirely omit the part intended for the "trained chemist," leaving that person to obtain his information on volumetric solutions from the proper sources. R. J. F.

An Easy Introduction to Chemistry. Edited by the Rev. Arthur Rigg, M.A., late Principal of the College, Chester. (Rivingtons: London, Oxford, and Cambridge, 1873.)

THE present work, founded, as the editor states, on a "First Book of Chemistry," by Dr. Worthington Hooker, published in America, is intended for the use of children. Mr. Rigg calls attention to the inquiries of "young persons" as generally suggested by their observations of things touched and handled, and states that his aim has been "To supply information in a form which it is hoped may be intelligible and interesting to all parties concerned in thus learning to read the ever open book of nature."

The intention is a worthy one, and we have no doubt that the work will serve its purpose in instructing some of its readers, though we doubt if it will prove very intelligible for "persons" so young as those to whom the style of its commencement would seem to prescribe its use. We do not say this with any desire to find fault, for it would indeed be difficult to place the information in a simpler form than has been done, but because of the great difficulty of convincing young minds of the alterability of matter. Either talking or reading alone is quite incompetent to do this. Without experimental illustration they are utterly meaningless except to well-advanced intellects, and even there cannot do much, as anyone can tell who has had the honour of meeting the chemist whose knowledge extends not beyond books. In fact, chemistry is not to be taught without the laboratory and its experiments, and Mr. Rigg has shown his sense of their importance by the insertion of 46 beautifully-executed woodcuts of experiments and a frontispiece of a laboratory with its apparatus and fittings.

Excepting in a school, however, the "young persons" of the preface are not likely to meet with the actual experiments of which illustrations are supplied, and those that are of sufficient age to go to such a school might surely have a rather more advanced book placed in their hands. The question, however, which a reviewer ought to ask himself is, Is the book such a one as would fairly carry out the author's intention? and to this we must, in this case, answer "Yes." Granting the possibility of teaching chemistry to young children, Mr. Rigg's book would certainly serve its purpose well. With regard to his facts, Mr. Rigg is, as a rule, sound; but we must demur to his statement on p. 134, that "If (silica) is to these (grasses and grain) and other plants very much what bones are to animals;" and again, on p. 167, "Every stalk of grain or grass is chiefly wood. In both cases fine particles of flint are scattered in the wood to make it firm enough to stand even in a gale of wind." The experiments of Sachs and others have long since disproved this theory. Such blemishes as these are, however, of but little moment when the main principles of the science are the object of teaching, and on these Mr. Rigg is perfectly orthodox. We must, in conclusion, compliment the publishers on the very elegant get-up of the book.

Die Rohstoffe des Pflanzenreiches: Versuch einer technischen Rohstofflehre des Pflanzenreiches. Von Dr. Julius Wiesner. (Leipzig: Engelmann, 1873. London: Williams and Norgate.)

THIS is one of those elaborate German works which seem as if they were intended completely to exhaust the subject of which they treat. Every substance of economical or technical importance which is obtained from the vegetable kingdom is treated of in detail from the point of view of its practical utility rather than its physiological history; its chemical, mechanical, and microscopical properties, the mode of its preparation or manufacture, and its utility in the arts or commerce, are described. The book is, in fact, a repertorium of technical botany.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. No notice is taken of anonymous communications.*]

On a Proposed Statistical Scale

AT a lecture last Friday evening, at the Royal Institution, I spoke on a subject which happens to lie at the meeting-point of many special sciences, and therefore, as I am desirous of having it well discussed, and from many points of view, it seems to me best to state it afresh in your columns for that purpose. It refers to the *definition* of the estimated *degree of development* of any quality whatever, without reference to external standards of measurement. The scale I propose depends on two processes; the one is securely based on the law of statistical constancy, the other is doubtfully based on the law of frequency of error. (1) At present we are accustomed to deal with averages and the like, which can only be obtained by measuring *every* individual by a *detached standard scale*, and going through an arithmetical process afterwards. Now I want to deal with cases for which no external standard exists, and I propose to proceed in quite another way, on the principle that *intercomparison* suffices to define. We have only to range our group in a long series, beginning with the biggest and ending with the smallest; and then we know by the law of statistical constancy that the individual who occupies the half-way point, or any other fractional position of the entire length, will be of the same size as the individual who occupies a similar position in any other statistical group of similar objects. We state his size with statistical precision by saying that his place is so and so in a series. We appeal to a standard which lies dormant in every group, and which a statistician can evoke, for temporary purposes of comparison, whenever he will. (2) What places in the